

APPENDIX A

Dosimetry Data

All dosimetry data is from

Rittman, P. D., 2003, *Exposure Scenarios and Unit Dose Factors for Hanford Tank Waste Performance Assessments*, HNF-SD-WM-TI-707, Rev. 3, CH2M HILL Hanford Group, Inc., Richland, Washington.

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Table A-1. Radionuclides to be Considered and Their Half Lives. (2 pages)

Nuclide	Half life (years)	Short-lived progeny in equilibrium with parent
H-3	12.33	
Be-10	1.60E+06	
C-14	5,730	
Na-22	2.6019	
Si-32+D	329.56	P-32
Cl-36	300,992	
K-40	1.28E+09	
Ti-44+D	47.3	Sc-44
V-49	0.92539 (338 d)	
Mn-54	0.85454 (312.12 d)	
Fe-55	2.7299	
Co-60	5.2713	
Ni-59	74,999	
Ni-63	100.1	
Se-79	805,000	
Rb-87	4.80E+10	
Sr-90+D	28.149	Y-90
Zr-93	1.53E+06	
Nb-91	680	
Nb-93m	16.13	
Nb-94	20,300	
Mo-93	3,500	
Tc-99	11,097	
Ru-106+D	1.01736 (371.59 d)	Rh-106
Pd-107	6.50E+06	
Ag-108m+ D	127	Ag-108 (0.087)
Cd-109	1.26653 (462.6 d)	
Cd-113m	14.1	
In-115	4.41E+14	
Sn-121m+D	54.998	Sn-121 (0.776)
Sn-126+D	246,000	Sb-126m, Sb-126 (0.14)
Sb-125	2.7299	
Te-125m	0.15880 (58 d)	
I-129	1.57E+07	
Cs-134	2.0619	
Cs-135	2.30E+06	
Cs-137+D	29.999	Ba-137m (0.9443)
Ba-133	10.52	
Pm-147	2.6233	
Sm-147	1.06E+11	
Sm-151	89.997	
Eu-150	35.798	
Eu-152	13.33	
Eu-154	8.5919	
Eu-155	4.68	
Gd-152	1.08E+14	

Table A-1. Radionuclides to be Considered and Their Half Lives. (2 pages)

Nuclide	Half life (years)	Short-lived progeny in equilibrium with parent
Ho-166m	1,200	
Re-187	5.00E+10	
Tl-204	3.7801	
Pb-205	1.52E+07	
Pb-210+D	22.3	Bi-210
Bi-207	32.198	
Po-209	102	
Po-210	0.37886 (138.38 d)	
Ra-226+D	1,600	Rn-222, Po-218, Pb-214, Bi-214, Po-214(0.9998)
Ra-228+D	5.7498	Ac-228 Ac-227+D 21.769 Th-227 (0.9862), Fr-223 (0.0138), Ra-223, Rn-219, Po-215, Pb-211, Bi-211, Tl-207 (.99725), Po-211 (.00275)
Th-228+D	1.9129	Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Po-212 (0.6406), Tl-208 (0.3594)
Th-229+D	7,340	Ra-225, Ac-225, Fr-221, At-217, Bi213, Po-21 3(0.9784), Tl-209 (0.0216)
Th-230	75,380	
Th-232	1.41E+10	
Pa-231	32,759	
U-232	69.799	
U-233	159,198	
U-234	245,694	
U-235+D	7.04E+08	Th-231
U-236	2.34E+07	
U-238+D	4.47E+09	Th-234, Pa-234m, Pa-234 (0.0013)
Np-237+D	2.14E+06	Pa-233
Pu-236	2.8999	
Pu-238	87.697	
Pu-239	24,110	
Pu-240	6,563	
Pu-241+D	14.35	U-237 (2.39E-05)
Pu-242	373,507	
Pu-244+D	8.00E+07	U-240 (0.9988), Np-240m, Np-240 (0.0012)
Am-241	432.7	
Am-242m+D	141	Am-242(0.9955), Np-238(0.0045)
Am-243+D	7,370	Np-239
Cm-242	0.44611 (162.94 d)	
Cm-243	28.499	
Cm-244	18.1	
Cm-245	8,500	
Cm-246	4,730	
Cm-247+D	1.600E+07	Pu-243
Cm-248	339,981	
Cm-250+D	11,300	Pu-246 (0.25), Am-246(0.25), Bk-250(0.14)
Bk-247	1,394	
Cf-248	0.91294 (333.45 d)	
Cf-249	350.6	
Cf-250	13.08	
Cf-251	897.98	
Cf-252	2.6449	

Note: Parentheses show (1) half-lives that are normally given in days, and (2) branching ratios that differ from 1.00.

Table A-2. Decay Chains Actually Computed

Zr-93	→	Nb-93m
Mo-93	→	Nb-93m
Sb-125	→	Te-125m 0.23
Pm-147	→	Sm-147
Eu-152	→	Gd-152 0.2792
Pb-210	→	Po-210
Po-209	→	Pb-205 0.9974
Ra-226	→	Pb-210 → Po-210
Ra-228	→	Th-228
Th-230	→	Ra-226 → Pb-210 → Po-210
Th-232	→	Ra-228 → Th-228
Pa-231	→	Ac-227
U-232	→	Th-228
U-233	→	Th-229
U-234	→	Th-230 → Ra-226 → Pb-210
U-235	→	Pa-231 → Ac-227
Pu-236	→	U-232 → Th-228
Pu-238	→	U-234
Pu-241	→	Am-241 → Np-237
Pu-244	→	Pu-240
Am-241	→	Np-237
Am-242m	→	Cm-242 → Pu-238 → U-234 0.827 0.173
Am-243	→	Pu-239
Cm-242	→	Pu-238 → U-234
Cm-243	→	Pu-239 Am-243 0.0024
Cm-244	→	Pu-240
Cm-245	→	Pu-241 → Am-241 → Np-237
Cm-247	→	Am-243
Cm-250	→	Cf-250 0.14 0.25
Bk-247	→	Am-243
Cf-248	→	Cm-244 → Pu-240
Cf-249	→	Cm-245 → Pu-241 → Am-241
Cf-250	→	Cm-246
Cf-251	→	Cm-247
Cf-252	→	Cm-248

Notes:

- 1) Decay times are assumed to be less than 1000 years so that the ingrowth of progeny with long half-lives can be ignored.
- 2) There is a slight increase in the Pu-238 and U-234 for the Am-242m decay chain that is not shown. This is a result of the low-probability alpha decay of Am-242m. The complete chain is, Am-242m (0.00455)--->Np-238--->Pu-238--->U-234.

Table A-3. Exposure Pathway Summary for Standard Performance Assessment Scenarios.

Exposure Scenarios → Exposure Pathways		A.1.1.1.1 Standard Performance Assessment Exposure Scenarios								
		Waste Intruders				All Pathways Farmer		Native American		Columbia River Population
		Driller	Sub. Res.	Rural Res.	Com. Farm	GW	River	GW	River	
Water	Ingestion					•	•	•	•	•
	Vapor Inhalation					•	•	•	•	•
	Shower, dermal					•	•	•	•	•
	Swimming, dermal							•	•	
	Sweat Lodge, inhalation							•	•	
Shore Sediments	Ingestion						•		•	•
	Inhalation									
	Dermal Contact					•		•	•	•
	External Radiation Dose					•		•	•	•
Soil	Ingestion	•	•	•	•	•	•	•	•	•
	Inhalation	•	•	•	•	•	•	•	•	•
	Dermal Contact					•	•	•	•	•
	External Radiation Dose	•	•	•	•	•	•	•	•	•
	Tritium Vapor Inhalation		•			•	•	•	•	•
Food Chain	Garden Produce		•			•	•	•	•	•
	Grains									
	Beef & Milk			Dairy only		•	•	•	•	•
	Poultry & Egg					•	•	•	•	•
	Fish						•		•	•
	Wild Game								•	

The annual dose equivalent (in mrem) is calculated for all of the exposure scenarios shown on this table. This is the only risk quantifier for the waste intruders. The other exposure scenarios also have incremental cancer risk from a lifetime exposure for both radionuclides and chemicals, and hazard index for chemicals.

Table A-4. Exposure Pathway Summary for HSRAm and MTCA Scenarios.

Exposure Scenarios → Exposure Pathways		Hanford Site Risk Assessment Methodology (HSRAm)						WAC 173-340		
		Indus- trial	Recreational		Residential		Agricultural		MTCA B & C	
			GW	River	GW	River	GW	River	GW	River
Water	Ingestion	•	•	•	•	•	•	•	•	•
	Vapor Inhalation	•	•	•	•	•	•	•		
	Shower, dermal	•	•	•	•	•	•	•		
	Swimming, dermal			•		•		•		
	Sweat Lodge, inhalation									
Shore Sediments	Ingestion			•		•		•		
	Inhalation									
	Dermal Contact			•		•		•		
	External Radiation Dose			•		•		•		
Soil	Ingestion	•	•	•	•	•	•	•		
	Inhalation	•	•	•	•	•	•	•		
	Dermal Contact	•	•	•	•	•	•	•		
	External Radiation Dose	•	•	•	•	•	•	•		
	Tritium Vapor Inhalation	•	•	•	•	•	•	•		
Food Chain	Garden Produce				•	•	•	•		
	Grains									
	Beef & Milk						•	•		
	Poultry & Egg									
	Fish			•		•		•		•
	Wild Game			•				•		

The annual dose equivalent (in mrem) is not calculated for the exposure scenarios shown on this table. The risk quantifiers for these scenarios are incremental cancer risk from a lifetime exposure for radionuclides

For the dose and risk factors in the ensuing tables, please note the following:

- The nuclides with "+D" have short half life progeny in secular equilibrium.
- All doses (mrem or person-rem) are the 50 year committed EDE from the first year of intake. All risks are the lifetime averages.
- Well Driller dose factor is mrem per Ci/kg. The Ci/kg is the total Ci exhumed divided by the total mass of soil & waste removed from the well.
- Post-Intrusion Resident dose factor is in mrem per Ci exhumed.
- Population numbers are the total for 5 million persons. All other dose/risk factors are per pCi/L in the water used.
- Major individual pathways are shown for intruder scenarios, only the total dose/risk are given for other pathways, please see Rittman (2003) for individual pathway contributions.

Table A-5. Scenario Dose Factors for the Well Driller, mrem per Ci/kg in borehole cuttings

Nuclide	Total	External	Internal	Soil Inhalation	Soil Ingestion
H-3	3.25E+01	0.00E+00	3.25E+01	4.65E-01	3.20E+01
Be-10	5.65E+03	1.61E+03	4.04E+03	1.71E+03	2.33E+03
C-14	1.08E+03	2.05E+01	1.06E+03	1.01E+01	1.05E+03
Na-22	1.79E+07	1.79E+07	5.79E+03	3.71E+01	5.75E+03
Al-26	2.20E+07	2.20E+07	7.36E+03	7.06E+01	7.29E+03
Si-32+D	2.76E+04	1.71E+04	1.05E+04	4.99E+03	5.50E+03
Cl-36	5.10E+03	3.48E+03	1.62E+03	1.06E+02	1.52E+03
K-40	1.31E+06	1.30E+06	9.36E+03	6.00E+01	9.30E+03
Ca-41	6.43E+02	0.00E+00	6.43E+02	6.16E+00	6.36E+02
Ti-44+D	1.80E+07	1.80E+07	1.45E+04	2.19E+03	1.23E+04
V-49	3.24E+01	0.00E+00	3.24E+01	1.67E+00	3.07E+01
Mn-54	6.81E+06	6.81E+06	1.42E+03	3.24E+01	1.39E+03
Fe-55	3.10E+02	0.00E+00	3.10E+02	6.49E+00	3.04E+02
Fe-60+D	7.75E+04	1.71E+01	7.75E+04	1.31E+03	7.62E+04
Co-60	2.06E+07	2.06E+07	1.36E+04	1.60E+02	1.35E+04
Ni-59	1.09E+02	0.00E+00	1.09E+02	4.44E+00	1.05E+02
Ni-63	3.00E+02	0.00E+00	3.00E+02	1.11E+01	2.89E+02
Se-79	4.41E+03	2.83E+01	4.38E+03	3.17E+01	4.35E+03
Rb-87	2.69E+03	2.14E+02	2.48E+03	1.56E+01	2.46E+03
Sr-90+D	1.13E+05	3.51E+04	7.77E+04	1.20E+03	7.65E+04
Zr-93	1.23E+03	0.00E+00	1.23E+03	4.03E+02	8.30E+02
Nb-91	1.75E+04	1.72E+04	2.77E+02	1.55E+01	2.61E+02
Nb-93m	4.35E+02	1.58E+02	2.77E+02	1.55E+01	2.61E+02
Nb-94	1.29E+07	1.29E+07	3.74E+03	1.75E+02	3.57E+03
Mo-93	1.71E+03	8.97E+02	8.12E+02	1.37E+02	6.75E+02
Tc-99	9.61E+02	1.91E+02	7.70E+02	4.03E+01	7.30E+02
Ru-106+D	1.76E+06	1.75E+06	1.43E+04	5.71E+02	1.37E+04
Pd-107	1.36E+02	0.00E+00	1.36E+02	6.20E+01	7.45E+01
Ag-108m+D	1.31E+07	1.31E+07	3.93E+03	1.22E+02	3.81E+03
Cd-109	2.95E+04	2.24E+04	7.10E+03	5.52E+02	6.55E+03
Cd-113m	8.89E+04	9.72E+02	8.79E+04	7.41E+03	8.05E+04
In-115	9.77E+04	6.03E+02	9.71E+04	1.81E+04	7.90E+04
Sn-121m+D	4.39E+03	3.21E+03	1.18E+03	5.76E+01	1.13E+03
Sn-126+D	1.61E+07	1.61E+07	1.10E+04	4.89E+02	1.05E+04
Sb-125	3.36E+06	3.36E+06	1.46E+03	5.90E+01	1.41E+03
Te-125m	2.49E+04	2.30E+04	1.87E+03	3.53E+01	1.84E+03
I-129	1.59E+05	1.97E+04	1.39E+05	8.42E+02	1.38E+05
Cs-134	1.28E+07	1.27E+07	3.69E+04	2.24E+02	3.67E+04
Cs-135	3.62E+03	5.82E+01	3.56E+03	2.20E+01	3.54E+03
Cs-137+D	4.62E+06	4.59E+06	2.52E+04	1.54E+02	2.50E+04
Ba-133	2.81E+06	2.81E+06	1.74E+03	3.78E+01	1.70E+03
Pm-147	7.91E+02	7.59E+01	7.15E+02	1.90E+02	5.25E+02
Sm-147	4.54E+05	0.00E+00	4.54E+05	3.62E+05	9.25E+04
Sm-151	3.41E+02	1.50E+00	3.40E+02	1.45E+02	1.95E+02
Eu-150	1.19E+07	1.19E+07	4.48E+03	1.30E+03	3.18E+03
Eu-152	9.15E+06	9.15E+06	4.31E+03	1.07E+03	3.24E+03
Eu-154	1.00E+07	1.00E+07	6.16E+03	1.38E+03	4.78E+03
Eu-155	2.78E+05	2.77E+05	9.65E+02	2.00E+02	7.65E+02
Gd-152	1.26E+06	0.00E+00	1.26E+06	1.18E+06	8.05E+04
Ho-166m	1.39E+07	1.39E+07	7.78E+03	3.74E+03	4.04E+03
Re-187	5.02E+00	0.00E+00	5.02E+00	2.63E-01	4.76E+00

Table A-5. Scenario Dose Factors for the Well Driller, mrem per Ci/kg in borehole cuttings

Nuclide	Total	External	Internal	Soil Inhalation	Soil Ingestion
Tl-204	7.81E+03	6.12E+03	1.69E+03	1.17E+01	1.68E+03
Pb-205	8.45E+02	1.07E+01	8.34E+02	1.90E+01	8.15E+02
Pb-210+D	2.76E+06	9.00E+03	2.75E+06	6.58E+04	2.69E+06
Bi-207	1.23E+07	1.23E+07	2.84E+03	9.68E+01	2.74E+03
Po-209	1.26E+06	2.69E+04	1.24E+06	5.18E+04	1.19E+06
Po-210	9.92E+05	6.96E+01	9.92E+05	4.15E+04	9.50E+05
Ra-226+D	1.50E+07	1.43E+07	7.07E+05	4.16E+04	6.65E+05
Ra-228+D	8.60E+06	7.86E+06	7.44E+05	2.35E+04	7.20E+05
Ac-227+D	1.87E+07	2.88E+06	1.58E+07	8.42E+06	7.40E+06
Th-228+D	1.47E+07	1.26E+07	2.06E+06	1.66E+06	4.06E+05
Th-229+D	1.27E+07	2.24E+06	1.04E+07	8.42E+06	2.02E+06
Th-230	1.54E+06	1.82E+03	1.54E+06	1.27E+06	2.74E+05
Th-232	6.93E+06	7.89E+02	6.93E+06	5.57E+06	1.37E+06
Pa-231	1.18E+07	2.73E+05	1.15E+07	6.20E+06	5.30E+06
U-232	7.28E+05	1.36E+03	7.27E+05	7.21E+04	6.55E+05
U-233	1.85E+05	2.06E+03	1.83E+05	3.87E+04	1.45E+05
U-234	1.80E+05	6.09E+02	1.80E+05	3.81E+04	1.42E+05
U-235+D	1.29E+06	1.12E+06	1.69E+05	3.53E+04	1.34E+05
U-236	1.71E+05	3.24E+02	1.71E+05	3.60E+04	1.35E+05
U-238+D	3.44E+05	1.76E+05	1.68E+05	3.42E+04	1.34E+05
Np-237+D	6.42E+06	1.58E+06	4.83E+06	2.61E+06	2.22E+06
Pu-236	1.29E+06	3.42E+02	1.29E+06	7.02E+05	5.85E+05
Pu-238	3.50E+06	2.30E+02	3.50E+06	1.90E+06	1.60E+06
Pu-239	3.85E+06	4.32E+02	3.85E+06	2.08E+06	1.77E+06
Pu-240	3.85E+06	2.23E+02	3.85E+06	2.08E+06	1.77E+06
Pu-241+D	7.42E+04	2.79E+01	7.42E+04	3.99E+04	3.43E+04
Pu-242	3.67E+06	1.95E+02	3.67E+06	1.99E+06	1.68E+06
Pu-244+D	6.32E+06	2.71E+06	3.61E+06	1.95E+06	1.66E+06
Am-241	4.04E+06	6.66E+04	3.97E+06	2.15E+06	1.82E+06
Am-242m+D	3.92E+06	9.84E+04	3.82E+06	2.06E+06	1.76E+06
Am-243+D	5.27E+06	1.33E+06	3.94E+06	2.13E+06	1.82E+06
Cm-242	1.41E+05	2.58E+02	1.41E+05	8.37E+04	5.75E+04
Cm-243	3.60E+06	8.58E+05	2.74E+06	1.49E+06	1.26E+06
Cm-244	2.21E+06	1.92E+02	2.21E+06	1.20E+06	1.01E+06
Cm-245	4.59E+06	5.13E+05	4.07E+06	2.20E+06	1.87E+06
Cm-246	4.03E+06	1.77E+02	4.03E+06	2.18E+06	1.85E+06
Cm-247+D	6.34E+06	2.62E+06	3.71E+06	2.00E+06	1.71E+06
Cm-248	1.48E+07	1.34E+02	1.48E+07	7.99E+06	6.80E+06
Cm-250+D	8.69E+07	2.57E+06	8.43E+07	4.55E+07	3.89E+07
Bk-247	5.77E+06	6.42E+05	5.13E+06	2.78E+06	2.35E+06
Cf-248	3.82E+05	1.90E+02	3.82E+05	2.15E+05	1.67E+05
Cf-249	7.78E+06	2.61E+06	5.16E+06	2.79E+06	2.37E+06
Cf-250	2.33E+06	1.80E+02	2.33E+06	1.27E+06	1.07E+06
Cf-251	6.06E+06	7.86E+05	5.27E+06	2.85E+06	2.43E+06
Cf-252	1.20E+06	2.67E+02	1.20E+06	6.63E+05	5.40E+05

Table A-6. Scenario Dose Factors for the Post Intruder Resident (Suburban resident with 100 m² garden), mrem per Ci exhumed. (2 pages)

Nuclide	Total	External	Internal	Soil Inhalation	Soil Ingestion	Vegetables
H-3	3.19E+00	0.00E+00	3.19E+00	3.04E-01	8.71E-04	2.89E+00
Be-10	1.24E+01	9.66E-01	1.14E+01	1.37E+00	3.73E+00	6.31E+00
C-14	6.22E+02	1.21E-02	6.22E+02	7.89E-03	1.63E+00	6.20E+02
Na-22	1.14E+04	1.01E+04	1.36E+03	2.60E-02	8.06E+00	1.35E+03
Al-26	1.32E+04	1.32E+04	2.48E+01	5.64E-02	1.17E+01	1.31E+01
Si-32+D	4.13E+02	1.02E+01	4.03E+02	3.96E+00	8.75E+00	3.90E+02
Cl-36	8.26E+04	1.90E+00	8.26E+04	7.32E-02	2.10E+00	8.26E+04
K-40	5.29E+03	7.71E+02	4.52E+03	4.72E-02	1.46E+01	4.51E+03
Ca-41	2.61E+02	0.00E+00	2.61E+02	4.83E-03	1.00E+00	2.60E+02
Ti-44+D	1.08E+04	1.08E+04	6.76E+01	1.73E+00	1.95E+01	4.63E+01
V-49	1.25E-01	0.00E+00	1.25E-01	9.39E-04	3.46E-02	8.93E-02
Mn-54	3.59E+03	3.36E+03	2.35E+02	1.77E-02	1.52E+00	2.34E+02
Fe-55	1.70E+00	0.00E+00	1.70E+00	4.58E-03	4.29E-01	1.26E+00
Fe-60+D	9.13E+02	4.15E+02	4.98E+02	1.05E+00	1.23E+02	3.74E+02
Co-60	1.25E+04	1.19E+04	5.85E+02	1.20E-01	2.01E+01	5.65E+02
Ni-59	5.70E+00	0.00E+00	5.70E+00	3.55E-03	1.68E-01	5.53E+00
Ni-63	1.56E+01	0.00E+00	1.56E+01	8.86E-03	4.60E-01	1.52E+01
Se-79	9.98E+01	1.61E-02	9.98E+01	2.34E-02	6.44E+00	9.33E+01
Rb-87	1.91E+03	1.28E-01	1.91E+03	1.25E-02	3.92E+00	1.90E+03
Sr-90+D	3.57E+04	2.09E+01	3.57E+04	9.43E-01	1.21E+02	3.56E+04
Zr-93	3.36E+00	1.01E-03	3.36E+00	3.22E-01	1.34E+00	1.70E+00
Nb-91	1.49E+01	1.03E+01	4.53E+00	1.24E-02	4.17E-01	4.10E+00
Nb-93m	4.55E+00	9.40E-02	4.46E+00	1.21E-02	4.08E-01	4.04E+00
Nb-94	7.78E+03	7.72E+03	6.19E+01	1.39E-01	5.71E+00	5.61E+01
Mo-93	4.60E+02	5.31E-01	4.59E+02	1.08E-01	1.07E+00	4.58E+02
Tc-99	5.06E+03	1.09E-01	5.06E+03	2.98E-02	1.08E+00	5.06E+03
Ru-106+D	1.35E+03	8.89E+02	4.62E+02	3.31E-01	1.59E+01	4.45E+02
Pd-107	3.10E+00	0.00E+00	3.10E+00	4.93E-02	1.19E-01	2.93E+00
Ag-108m+D	7.86E+03	7.85E+03	1.39E+01	9.74E-02	6.07E+00	7.70E+00
Cd-109	7.98E+02	1.17E+01	7.86E+02	3.39E-01	8.05E+00	7.77E+02
Cd-113m	1.15E+04	5.75E-01	1.15E+04	5.76E+00	1.25E+02	1.14E+04
In-115	2.67E+02	3.62E-01	2.66E+02	1.45E+01	1.26E+02	1.26E+02
Sn-121m+D	1.17E+01	1.92E+00	9.82E+00	4.57E-02	1.79E+00	7.98E+00
Sn-126+D	9.74E+03	9.65E+03	9.20E+01	3.90E-01	1.68E+01	7.48E+01
Sb-125	1.92E+03	1.90E+03	2.84E+01	4.62E-02	2.46E+00	2.59E+01
Te-125m	8.75E+00	5.61E+00	3.14E+00	6.37E-03	6.64E-01	2.47E+00
I-129	2.88E+03	1.17E+01	2.87E+03	6.65E-01	2.18E+02	2.65E+03
Cs-134	1.21E+04	7.02E+03	5.10E+03	1.52E-01	4.98E+01	5.05E+03
Cs-135	5.55E+02	3.49E-02	5.55E+02	1.76E-02	5.66E+00	5.50E+02
Cs-137+D	6.63E+03	2.74E+03	3.89E+03	1.22E-01	3.95E+01	3.85E+03
Ba-133	1.71E+03	1.65E+03	5.43E+01	2.91E-02	2.63E+00	5.17E+01
Pm-147	3.19E+00	4.27E-02	3.15E+00	1.33E-01	7.38E-01	2.28E+00
Sm-147	8.77E+02	0.00E+00	8.77E+02	2.89E+02	1.48E+02	4.41E+02
Sm-151	1.35E+00	8.96E-04	1.35E+00	1.15E-01	3.10E-01	9.24E-01
Eu-150	7.11E+03	7.09E+03	2.11E+01	1.03E+00	5.04E+00	1.51E+01
Eu-152	5.44E+03	5.42E+03	2.10E+01	8.32E-01	5.05E+00	1.52E+01
Eu-154	5.92E+03	5.89E+03	3.05E+01	1.06E+00	7.34E+00	2.21E+01
Eu-155	1.65E+02	1.60E+02	4.75E+00	1.49E-01	1.14E+00	3.46E+00
Gd-152	1.45E+03	0.00E+00	1.45E+03	9.39E+02	1.29E+02	3.84E+02
Ho-166m	8.38E+03	8.35E+03	2.87E+01	2.99E+00	6.45E+00	1.92E+01
Re-187	1.64E+00	0.00E+00	1.64E+00	2.10E-04	7.59E-03	1.63E+00

Table A-6. Scenario Dose Factors for the Post Intruder Resident (Suburban resident with 100 m² garden), mrem per Ci exhumed. (2 pages)

Nuclide	Total	External	Internal	Soil Inhalation	Soil Ingestion	Vegetables
Tl-204	8.49E+00	3.51E+00	4.98E+00	8.51E-03	2.46E+00	2.51E+00
Pb-205	7.47E+00	6.44E-03	7.47E+00	1.52E-02	1.30E+00	6.15E+00
Pb-210+D	2.72E+04	5.37E+00	2.72E+04	6.95E+01	5.04E+03	2.21E+04
Bi-207	7.38E+03	7.36E+03	2.20E+01	7.65E-02	4.34E+00	1.76E+01
Po-209	7.46E+03	1.61E+01	7.44E+03	4.12E+01	1.89E+03	5.51E+03
Po-210	3.03E+03	2.74E-02	3.03E+03	1.52E+01	6.97E+02	2.32E+03
Ra-226+D	1.41E+04	8.60E+03	5.51E+03	3.43E+01	1.14E+03	4.33E+03
Ra-228+D	1.09E+04	5.21E+03	5.73E+03	2.22E+02	1.19E+03	4.32E+03
Ac-227+D	3.12E+04	1.72E+03	2.95E+04	6.62E+03	1.17E+04	1.12E+04
Th-228+D	9.05E+03	6.91E+03	2.13E+03	1.11E+03	5.44E+02	4.79E+02
Th-229+D	1.40E+04	1.34E+03	1.26E+04	6.73E+03	3.22E+03	2.68E+03
Th-230	1.82E+03	2.02E+00	1.82E+03	1.01E+03	4.39E+02	3.65E+02
Th-232	8.85E+03	1.53E+02	8.70E+03	4.46E+03	2.25E+03	1.99E+03
Pa-231	2.15E+04	1.78E+02	2.13E+04	5.06E+03	8.67E+03	7.60E+03
U-232	7.58E+03	6.38E+02	6.94E+03	2.64E+02	1.12E+03	5.56E+03
U-233	1.47E+03	1.25E+00	1.47E+03	3.05E+01	2.26E+02	1.22E+03
U-234	1.44E+03	3.60E-01	1.44E+03	2.98E+01	2.21E+02	1.19E+03
U-235+D	2.02E+03	6.63E+02	1.36E+03	2.76E+01	2.09E+02	1.12E+03
U-236	1.37E+03	1.91E-01	1.37E+03	2.81E+01	2.10E+02	1.13E+03
U-238+D	1.47E+03	1.04E+02	1.36E+03	2.67E+01	2.09E+02	1.13E+03
Np-237+D	3.44E+04	9.46E+02	3.34E+04	2.07E+03	3.53E+03	2.78E+04
Pu-236	2.13E+03	1.24E+00	2.13E+03	5.00E+02	8.38E+02	7.90E+02
Pu-238	6.34E+03	1.37E-01	6.34E+03	1.51E+03	2.55E+03	2.28E+03
Pu-239	7.02E+03	2.59E-01	7.02E+03	1.66E+03	2.83E+03	2.53E+03
Pu-240	7.02E+03	1.34E-01	7.02E+03	1.66E+03	2.83E+03	2.53E+03
Pu-241+D	1.38E+02	3.24E-02	1.38E+02	3.25E+01	5.58E+01	4.95E+01
Pu-242	6.68E+03	1.17E-01	6.68E+03	1.59E+03	2.69E+03	2.40E+03
Pu-244+D	8.21E+03	1.63E+03	6.59E+03	1.56E+03	2.66E+03	2.37E+03
Am-241	7.24E+03	3.99E+01	7.20E+03	1.72E+03	2.91E+03	2.57E+03
Am-242m+D	7.10E+03	5.90E+01	7.04E+03	1.67E+03	2.85E+03	2.52E+03
Am-243+D	7.97E+03	7.96E+02	7.17E+03	1.70E+03	2.90E+03	2.57E+03
Cm-242	1.43E+02	1.08E-01	1.43E+02	3.77E+01	5.31E+01	5.22E+01
Cm-243	5.37E+03	5.12E+02	4.86E+03	1.17E+03	1.98E+03	1.71E+03
Cm-244	3.89E+03	1.14E-01	3.89E+03	9.41E+02	1.59E+03	1.37E+03
Cm-245	7.62E+03	3.08E+02	7.32E+03	1.76E+03	2.99E+03	2.56E+03
Cm-246	7.24E+03	1.06E-01	7.24E+03	1.74E+03	2.96E+03	2.54E+03
Cm-247+D	8.25E+03	1.57E+03	6.68E+03	1.60E+03	2.74E+03	2.34E+03
Cm-248	2.66E+04	8.01E-02	2.66E+04	6.38E+03	1.09E+04	9.32E+03
Cm-250+D	1.53E+05	1.54E+03	1.52E+05	3.63E+04	6.22E+04	5.33E+04
Bk-247	9.69E+03	3.85E+02	9.30E+03	2.22E+03	3.76E+03	3.33E+03
Cf-248	1.59E+03	9.56E-02	1.59E+03	1.35E+02	2.11E+02	1.25E+03
Cf-249	3.06E+04	1.57E+03	2.90E+04	2.23E+03	3.79E+03	2.30E+04
Cf-250	1.28E+04	1.07E-01	1.28E+04	9.86E+02	1.66E+03	1.01E+04
Cf-251	3.02E+04	4.71E+02	2.97E+04	2.27E+03	3.88E+03	2.35E+04
Cf-252	5.99E+03	1.50E-01	5.99E+03	4.66E+02	7.60E+02	4.77E+03

Table A-7. Scenario Dose Factors for the Post Intruder Resident (Rural Resident with Dairy Cow), mrem per Ci exhumed. (2 pages)

Nuclide	Total	External	Internal	Soil Inhalation	Soil Ingestion	Milk
H-3	1.08E-01	0.00E+00	1.08E-01	1.08E-01	1.74E-05	5.37E-06
Be-10	1.67E-01	3.86E-02	1.28E-01	5.31E-02	7.45E-02	2.32E-04
C-14	1.36E+01	4.80E-04	1.36E+01	3.07E-04	3.27E-02	1.35E+01
Na-22	4.25E+02	3.77E+02	4.74E+01	1.01E-03	1.61E-01	4.72E+01
Al-26	5.28E+02	5.27E+02	3.84E-01	2.19E-03	2.33E-01	1.48E-01
Si-32+D	8.05E-01	4.08E-01	3.97E-01	1.54E-01	1.75E-01	6.84E-02
Cl-36	2.66E+03	7.22E-02	2.66E+03	2.85E-03	4.19E-02	2.66E+03
K-40	1.41E+02	3.07E+01	1.11E+02	1.83E-03	2.93E-01	1.11E+02
Ca-41	1.00E+01	0.00E+00	1.00E+01	1.88E-04	2.00E-02	1.00E+01
Ti-44+D	4.42E+02	4.29E+02	1.32E+01	6.74E-02	3.91E-01	1.28E+01
V-49	7.72E-04	0.00E+00	7.72E-04	3.65E-05	6.91E-04	4.46E-05
Mn-54	1.12E+02	1.12E+02	6.26E-02	6.89E-04	3.04E-02	3.16E-02
Fe-55	9.58E-03	0.00E+00	9.58E-03	1.78E-04	8.58E-03	8.21E-04
Fe-60+D	3.46E+01	3.18E+01	2.86E+00	4.08E-02	2.47E+00	3.50E-01
Co-60	4.64E+02	4.62E+02	1.99E+00	4.65E-03	4.02E-01	1.58E+00
Ni-59	3.23E-01	0.00E+00	3.23E-01	1.38E-04	3.36E-03	3.19E-01
Ni-63	8.83E-01	0.00E+00	8.83E-01	3.44E-04	9.20E-03	8.73E-01
Se-79	2.35E+00	6.29E-04	2.35E+00	9.11E-04	1.29E-01	2.22E+00
Rb-87	4.70E+01	5.12E-03	4.69E+01	4.84E-04	7.85E-02	4.69E+01
Sr-90+D	9.66E+02	8.31E-01	9.65E+02	3.66E-02	2.42E+00	9.63E+02
Zr-93	3.94E-02	8.05E-05	3.93E-02	1.25E-02	2.67E-02	4.48E-05
Nb-91	4.21E-01	4.13E-01	8.83E-03	4.81E-04	8.34E-03	1.33E-05
Nb-93m	1.24E-02	3.72E-03	8.65E-03	4.72E-04	8.17E-03	1.30E-05
Nb-94	3.09E+02	3.09E+02	1.20E-01	5.42E-03	1.14E-01	1.81E-04
Mo-93	1.65E+00	2.11E-02	1.63E+00	4.18E-03	2.13E-02	1.61E+00
Tc-99	2.54E+01	4.23E-03	2.54E+01	1.16E-03	2.16E-02	2.54E+01
Ru-106+D	3.08E+01	3.04E+01	3.43E-01	1.29E-02	3.18E-01	1.24E-02
Pd-107	2.45E-01	0.00E+00	2.45E-01	1.92E-03	2.38E-03	2.41E-01
Ag-108m+D	3.13E+02	3.13E+02	1.49E-01	3.78E-03	1.21E-01	2.36E-02
Cd-109	5.15E+00	4.13E-01	4.73E+00	1.32E-02	1.61E-01	4.56E+00
Cd-113m	7.59E+01	2.27E-02	7.58E+01	2.24E-01	2.51E+00	7.31E+01
In-115	3.91E+00	1.45E-02	3.89E+00	5.62E-01	2.53E+00	8.04E-01
Sn-121m+D	2.72E-01	7.65E-02	1.95E-01	1.78E-03	3.58E-02	1.58E-01
Sn-126+D	3.88E+02	3.86E+02	1.83E+00	1.52E-02	3.36E-01	1.48E+00
Sb-125	7.14E+01	7.13E+01	8.14E-02	1.79E-03	4.91E-02	3.04E-02
Te-125m	1.60E-01	1.25E-01	3.53E-02	2.48E-04	1.33E-02	2.18E-02
I-129	2.89E+02	4.68E-01	2.89E+02	2.59E-02	4.37E+00	2.84E+02
Cs-134	4.48E+02	2.59E+02	1.89E+02	5.91E-03	9.96E-01	1.88E+02
Cs-135	2.19E+01	1.40E-03	2.19E+01	6.83E-04	1.13E-01	2.18E+01
Cs-137+D	2.62E+02	1.09E+02	1.53E+02	4.74E-03	7.91E-01	1.52E+02
Ba-133	6.53E+01	6.50E+01	3.07E-01	1.13E-03	5.25E-02	2.53E-01
Pm-147	2.26E-02	1.60E-03	2.10E-02	5.17E-03	1.48E-02	1.02E-03
Sm-147	1.44E+01	0.00E+00	1.44E+01	1.12E+01	2.96E+00	2.06E-01
Sm-151	1.11E-02	3.58E-05	1.11E-02	4.49E-03	6.20E-03	4.31E-04
Eu-150	2.82E+02	2.82E+02	1.48E-01	3.99E-02	1.01E-01	7.01E-03
Eu-152	2.14E+02	2.14E+02	1.40E-01	3.23E-02	1.01E-01	7.02E-03
Eu-154	2.31E+02	2.31E+02	1.98E-01	4.13E-02	1.47E-01	1.02E-02
Eu-155	6.21E+00	6.18E+00	3.01E-02	5.78E-03	2.27E-02	1.58E-03
Gd-152	3.92E+01	0.00E+00	3.92E+01	3.65E+01	2.58E+00	1.79E-01
Ho-166m	3.34E+02	3.34E+02	2.54E-01	1.16E-01	1.29E-01	8.98E-03
Re-187	1.71E-02	0.00E+00	1.71E-02	8.16E-06	1.52E-04	1.69E-02

Table A-7. Scenario Dose Factors for the Post Intruder Resident (Rural Resident with Dairy Cow), mrem per Ci exhumed. (2 pages)

Nuclide	Total	External	Internal	Soil Inhalation	Soil Ingestion	Milk
Tl-204	4.95E-01	1.34E-01	3.61E-01	3.31E-04	4.91E-02	3.12E-01
Pb-205	4.96E-02	2.58E-04	4.94E-02	5.89E-04	2.61E-02	2.27E-02
Pb-210+D	1.95E+02	2.14E-01	1.94E+02	2.70E+00	1.01E+02	9.09E+01
Bi-207	2.93E+02	2.93E+02	2.91E-01	2.97E-03	8.67E-02	2.01E-01
Po-209	7.94E+01	6.42E-01	7.87E+01	1.60E+00	3.78E+01	3.94E+01
Po-210	2.87E+01	7.66E-04	2.87E+01	5.91E-01	1.39E+01	1.42E+01
Ra-226+D	5.15E+02	3.44E+02	1.71E+02	1.33E+00	2.28E+01	1.47E+02
Ra-228+D	4.05E+02	2.24E+02	1.80E+02	8.63E+00	2.37E+01	1.48E+02
Ac-227+D	5.73E+02	6.81E+01	5.05E+02	2.57E+02	2.33E+02	1.47E+01
Th-228+D	3.08E+02	2.54E+02	5.41E+01	4.31E+01	1.09E+01	1.67E-01
Th-229+D	3.80E+02	5.36E+01	3.27E+02	2.61E+02	6.45E+01	9.92E-01
Th-230	4.84E+01	1.18E-01	4.83E+01	3.94E+01	8.77E+00	1.68E-01
Th-232	2.41E+02	1.29E+01	2.29E+02	1.73E+02	4.51E+01	1.03E+01
Pa-231	3.80E+02	7.65E+00	3.73E+02	1.96E+02	1.73E+02	2.88E+00
U-232	1.08E+02	4.77E+01	6.03E+01	1.03E+01	2.24E+01	2.76E+01
U-233	1.19E+01	5.07E-02	1.18E+01	1.18E+00	4.52E+00	6.12E+00
U-234	1.16E+01	1.43E-02	1.16E+01	1.16E+00	4.42E+00	5.99E+00
U-235+D	3.72E+01	2.63E+01	1.09E+01	1.07E+00	4.18E+00	5.66E+00
U-236	1.10E+01	7.60E-03	1.10E+01	1.09E+00	4.20E+00	5.70E+00
U-238+D	1.50E+01	4.13E+00	1.09E+01	1.04E+00	4.19E+00	5.68E+00
Np-237+D	1.91E+02	3.78E+01	1.53E+02	8.06E+01	7.06E+01	1.66E+00
Pu-236	3.65E+01	1.62E-01	3.63E+01	1.94E+01	1.68E+01	1.87E-01
Pu-238	1.10E+02	5.49E-03	1.10E+02	5.87E+01	5.10E+01	1.68E-01
Pu-239	1.21E+02	1.04E-02	1.21E+02	6.44E+01	5.66E+01	1.87E-01
Pu-240	1.21E+02	5.35E-03	1.21E+02	6.44E+01	5.66E+01	1.87E-01
Pu-241+D	2.38E+00	1.91E-03	2.38E+00	1.26E+00	1.12E+00	3.74E-03
Pu-242	1.16E+02	4.67E-03	1.16E+02	6.17E+01	5.38E+01	1.77E-01
Pu-244+D	1.79E+02	6.51E+01	1.14E+02	6.05E+01	5.31E+01	1.75E-01
Am-241	1.27E+02	1.60E+00	1.25E+02	6.66E+01	5.82E+01	2.63E-01
Am-242m+D	1.25E+02	2.36E+00	1.22E+02	6.50E+01	5.70E+01	3.42E-01
Am-243+D	1.56E+02	3.18E+01	1.24E+02	6.61E+01	5.81E+01	2.63E-01
Cm-242	2.59E+00	3.15E-03	2.58E+00	1.47E+00	1.06E+00	5.60E-02
Cm-243	1.08E+02	2.03E+01	8.76E+01	4.56E+01	3.97E+01	2.40E+00
Cm-244	7.02E+01	4.51E-03	7.02E+01	3.66E+01	3.17E+01	1.92E+00
Cm-245	1.44E+02	1.23E+01	1.32E+02	6.84E+01	5.99E+01	3.63E+00
Cm-246	1.31E+02	4.24E-03	1.31E+02	6.77E+01	5.92E+01	3.59E+00
Cm-247+D	1.83E+02	6.29E+01	1.20E+02	6.22E+01	5.47E+01	3.32E+00
Cm-248	4.79E+02	3.20E-03	4.79E+02	2.48E+02	2.18E+02	1.32E+01
Cm-250+D	2.79E+03	6.16E+01	2.73E+03	1.41E+03	1.24E+03	7.53E+01
Bk-247	1.77E+02	1.54E+01	1.62E+02	8.62E+01	7.52E+01	3.40E-01
Cf-248	9.49E+00	3.26E-03	9.49E+00	5.23E+00	4.22E+00	3.95E-02
Cf-249	2.25E+02	6.26E+01	1.63E+02	8.66E+01	7.57E+01	2.00E-01
Cf-250	7.16E+01	4.21E-03	7.16E+01	3.83E+01	3.32E+01	8.76E-02
Cf-251	1.85E+02	1.89E+01	1.66E+02	8.83E+01	7.75E+01	2.04E-01
Cf-252	3.33E+01	5.64E-03	3.33E+01	1.81E+01	1.52E+01	3.99E-02

Table A-8. Scenario Dose Factors for the Post Intruder Resident (Commercial Farmer), mrem per Ci exhumed. (2 pages)

Nuclide	Total	External	Internal	Soil Inhalation	Soil Ingestion
H-3	9.46E-03	0.00E+00	9.46E-03	9.46E-03	1.35E-07
Be-10	1.95E-03	5.97E-04	1.36E-03	7.80E-04	5.76E-04
C-14	2.64E-04	7.41E-06	2.57E-04	4.50E-06	2.52E-04
Na-22	5.83E+00	5.83E+00	1.26E-03	1.48E-05	1.25E-03
Al-26	8.15E+00	8.15E+00	1.83E-03	3.21E-05	1.80E-03
Si-32+D	9.91E-03	6.30E-03	3.61E-03	2.26E-03	1.35E-03
Cl-36	1.48E-03	1.12E-03	3.66E-04	4.18E-05	3.24E-04
K-40	4.76E-01	4.74E-01	2.29E-03	2.69E-05	2.26E-03
Ca-41	1.57E-04	0.00E+00	1.57E-04	2.76E-06	1.55E-04
Ti-44+D	6.63E+00	6.63E+00	4.01E-03	9.89E-04	3.02E-03
V-49	5.88E-06	0.00E+00	5.88E-06	5.35E-07	5.34E-06
Mn-54	1.73E+00	1.73E+00	2.45E-04	1.01E-05	2.35E-04
Fe-55	6.89E-05	0.00E+00	6.89E-05	2.61E-06	6.63E-05
Fe-60+D	5.11E-01	4.91E-01	1.97E-02	5.99E-04	1.91E-02
Co-60	7.15E+00	7.14E+00	3.18E-03	6.82E-05	3.11E-03
Ni-59	2.80E-05	0.00E+00	2.80E-05	2.02E-06	2.60E-05
Ni-63	7.61E-05	0.00E+00	7.61E-05	5.05E-06	7.11E-05
Se-79	1.02E-03	9.72E-06	1.01E-03	1.34E-05	9.95E-04
Rb-87	6.93E-04	7.91E-05	6.14E-04	7.10E-06	6.07E-04
Sr-90+D	3.21E-02	1.28E-02	1.92E-02	5.37E-04	1.87E-02
Zr-93	3.92E-04	1.24E-06	3.90E-04	1.84E-04	2.07E-04
Nb-91	6.45E-03	6.38E-03	7.15E-05	7.07E-06	6.44E-05
Nb-93m	1.27E-04	5.75E-05	7.00E-05	6.92E-06	6.31E-05
Nb-94	4.77E+00	4.77E+00	9.61E-04	7.95E-05	8.82E-04
Mo-93	5.53E-04	3.27E-04	2.26E-04	6.14E-05	1.65E-04
Tc-99	2.49E-04	6.54E-05	1.84E-04	1.70E-05	1.67E-04
Ru-106+D	4.73E-01	4.70E-01	2.64E-03	1.89E-04	2.46E-03
Pd-107	4.65E-05	0.00E+00	4.65E-05	2.81E-05	1.84E-05
Ag-108m+D	4.84E+00	4.84E+00	9.93E-04	5.55E-05	9.38E-04
Cd-109	7.83E-03	6.39E-03	1.44E-03	1.93E-04	1.24E-03
Cd-113m	2.30E-02	3.51E-04	2.27E-02	3.28E-03	1.94E-02
In-115	2.80E-02	2.24E-04	2.78E-02	8.25E-03	1.95E-02
Sn-121m+D	1.49E-03	1.18E-03	3.02E-04	2.61E-05	2.76E-04
Sn-126+D	5.97E+00	5.96E+00	2.82E-03	2.23E-04	2.60E-03
Sb-125	1.10E+00	1.10E+00	4.06E-04	2.63E-05	3.80E-04
Te-125m	2.04E-03	1.93E-03	1.06E-04	3.63E-06	1.03E-04
I-129	4.14E-02	7.23E-03	3.41E-02	3.79E-04	3.38E-02
Cs-134	4.01E+00	4.01E+00	7.78E-03	8.67E-05	7.70E-03
Cs-135	9.06E-04	2.16E-05	8.84E-04	1.00E-05	8.74E-04
Cs-137+D	1.69E+00	1.68E+00	6.18E-03	6.95E-05	6.11E-03
Ba-133	1.01E+00	1.01E+00	4.22E-04	1.66E-05	4.06E-04
Pm-147	2.15E-04	2.47E-05	1.90E-04	7.59E-05	1.14E-04
Sm-147	1.87E-01	0.00E+00	1.87E-01	1.65E-01	2.29E-02
Sm-151	1.14E-04	5.53E-07	1.14E-04	6.59E-05	4.79E-05
Eu-150	4.36E+00	4.36E+00	1.36E-03	5.85E-04	7.79E-04
Eu-152	3.31E+00	3.31E+00	1.26E-03	4.75E-04	7.81E-04
Eu-154	3.57E+00	3.57E+00	1.74E-03	6.06E-04	1.13E-03
Eu-155	9.58E-02	9.55E-02	2.61E-04	8.48E-05	1.76E-04
Gd-152	5.56E-01	0.00E+00	5.56E-01	5.36E-01	1.99E-02
Ho-166m	5.16E+00	5.16E+00	2.70E-03	1.70E-03	9.97E-04
Re-187	1.29E-06	0.00E+00	1.29E-06	1.20E-07	1.17E-06

Table A-8. Scenario Dose Factors for the Post Intruder Resident (Commercial Farmer), mrem per Ci exhumed. (2 pages)

Nuclide	Total	External	Internal	Soil Inhalation	Soil Ingestion
Tl-204	2.46E-03	2.07E-03	3.84E-04	4.85E-06	3.80E-04
Pb-205	2.14E-04	3.98E-06	2.10E-04	8.64E-06	2.02E-04
Pb-210+D	8.22E-01	3.30E-03	8.19E-01	3.96E-02	7.79E-01
Bi-207	4.52E+00	4.52E+00	7.14E-04	4.36E-05	6.70E-04
Po-209	3.25E-01	9.92E-03	3.16E-01	2.35E-02	2.92E-01
Po-210	1.16E-01	1.18E-05	1.16E-01	8.68E-03	1.08E-01
Ra-226+D	5.51E+00	5.32E+00	1.96E-01	1.95E-02	1.76E-01
Ra-228+D	3.78E+00	3.47E+00	3.10E-01	1.27E-01	1.83E-01
Ac-227+D	6.63E+00	1.05E+00	5.58E+00	3.78E+00	1.80E+00
Th-228+D	4.64E+00	3.92E+00	7.17E-01	6.33E-01	8.41E-02
Th-229+D	5.16E+00	8.29E-01	4.33E+00	3.84E+00	4.98E-01
Th-230	6.47E-01	1.83E-03	6.46E-01	5.78E-01	6.78E-02
Th-232	3.09E+00	1.99E-01	2.89E+00	2.54E+00	3.49E-01
Pa-231	4.34E+00	1.18E-01	4.22E+00	2.88E+00	1.34E+00
U-232	1.06E+00	7.37E-01	3.24E-01	1.51E-01	1.73E-01
U-233	5.31E-02	7.84E-04	5.23E-02	1.74E-02	3.49E-02
U-234	5.14E-02	2.21E-04	5.12E-02	1.70E-02	3.42E-02
U-235+D	4.55E-01	4.07E-01	4.80E-02	1.57E-02	3.23E-02
U-236	4.86E-02	1.17E-04	4.85E-02	1.60E-02	3.25E-02
U-238+D	1.11E-01	6.38E-02	4.76E-02	1.52E-02	3.24E-02
Np-237+D	2.31E+00	5.84E-01	1.73E+00	1.18E+00	5.45E-01
Pu-236	4.17E-01	2.50E-03	4.14E-01	2.85E-01	1.29E-01
Pu-238	1.26E+00	8.48E-05	1.26E+00	8.61E-01	3.94E-01
Pu-239	1.38E+00	1.60E-04	1.38E+00	9.46E-01	4.38E-01
Pu-240	1.38E+00	8.27E-05	1.38E+00	9.46E-01	4.38E-01
Pu-241+D	2.72E-02	2.96E-05	2.72E-02	1.85E-02	8.62E-03
Pu-242	1.32E+00	7.22E-05	1.32E+00	9.06E-01	4.15E-01
Pu-244+D	2.31E+00	1.01E+00	1.30E+00	8.89E-01	4.11E-01
Am-241	1.45E+00	2.47E-02	1.43E+00	9.78E-01	4.50E-01
Am-242m+D	1.43E+00	3.64E-02	1.39E+00	9.53E-01	4.40E-01
Am-243+D	1.91E+00	4.92E-01	1.42E+00	9.70E-01	4.49E-01
Cm-242	2.98E-02	4.87E-05	2.97E-02	2.15E-02	8.20E-03
Cm-243	1.29E+00	3.14E-01	9.75E-01	6.69E-01	3.07E-01
Cm-244	7.82E-01	6.98E-05	7.82E-01	5.37E-01	2.45E-01
Cm-245	1.66E+00	1.90E-01	1.47E+00	1.00E+00	4.63E-01
Cm-246	1.45E+00	6.55E-05	1.45E+00	9.94E-01	4.57E-01
Cm-247+D	2.31E+00	9.73E-01	1.34E+00	9.13E-01	4.23E-01
Cm-248	5.32E+00	4.95E-05	5.32E+00	3.64E+00	1.68E+00
Cm-250+D	3.13E+01	9.51E-01	3.03E+01	2.07E+01	9.61E+00
Bk-247	2.08E+00	2.38E-01	1.85E+00	1.27E+00	5.81E-01
Cf-248	1.09E-01	5.03E-05	1.09E-01	7.67E-02	3.26E-02
Cf-249	2.82E+00	9.68E-01	1.86E+00	1.27E+00	5.85E-01
Cf-250	8.19E-01	6.51E-05	8.19E-01	5.63E-01	2.56E-01
Cf-251	2.19E+00	2.91E-01	1.89E+00	1.30E+00	5.99E-01
Cf-252	3.83E-01	8.72E-05	3.83E-01	2.66E-01	1.17E-01

Table A-9. Dose and Risk Factors for the All-Pathways Farmer Scencario.
(2 pages)

Nuclide	Groundwater		Surface Water (Columbia River)	
	mrem per pCi/L	Risk per pCi/L	mrem per pCi/L	Risk per pCi/L
H-3	4.75E-05	2.66E-09	4.77E-05	2.67E-09
Be-10	3.09E-03	1.54E-07	4.63E-03	2.57E-07
C-14	4.85E-03	1.91E-07	3.49E-01	1.01E-05
Na-22	4.73E-02	2.86E-06	5.37E-02	3.03E-06
Si-32+D	7.23E-03	2.93E-07	8.00E-03	3.30E-07
Cl-36	2.49E-02	4.71E-06	2.54E-02	4.73E-06
K-40	2.88E-02	2.65E-06	9.16E-02	6.10E-06
Ti-44+D	5.81E-02	8.87E-06	1.69E-01	1.39E-05
V-49	4.16E-05	2.71E-09	8.20E-05	6.25E-09
Mn-54	6.07E-03	2.87E-07	1.05E-02	4.30E-07
Fe-55	5.94E-04	2.95E-08	9.94E-04	5.24E-08
Co-60	3.99E-02	4.12E-06	7.94E-02	5.15E-06
Ni-59	3.61E-04	1.99E-08	4.30E-04	2.38E-08
Ni-63	9.90E-04	4.83E-08	1.18E-03	5.78E-08
Se-79	1.29E-02	4.16E-07	1.78E-02	5.79E-07
Rb-87	8.40E-03	5.77E-07	4.08E-02	1.97E-06
Sr-90+D	1.53E-01	4.68E-06	1.83E-01	5.25E-06
Zr-93	1.05E-03	2.21E-08	2.69E-03	6.49E-08
Nb-91	3.44E-04	2.06E-08	8.92E-04	5.61E-08
Nb-93m	3.30E-04	1.65E-08	8.46E-04	5.13E-08
Nb-94	1.54E-02	5.82E-06	4.63E-02	7.17E-06
Mo-93	1.12E-03	1.40E-07	1.16E-03	1.44E-07
Tc-99	1.75E-03	6.98E-07	1.85E-03	7.06E-07
Ru-106+D	3.76E-02	2.22E-06	3.87E-02	2.29E-06
Pd-107	1.98E-04	1.42E-08	2.03E-04	1.46E-08
Ag-108m+D	1.67E-02	5.44E-06	3.93E-02	6.33E-06
Cd-109	9.44E-03	1.20E-07	1.81E-02	2.52E-07
Cd-113m	1.18E-01	7.65E-07	2.24E-01	1.49E-06
In-115	1.25E-01	8.96E-07	5.21E+01	4.28E-04
Sn-121m+D	4.56E-03	3.04E-07	2.68E-02	1.82E-06
Sn-126+D	5.62E-02	9.29E-06	2.94E-01	2.22E-05
Sb-125	4.37E-03	4.11E-07	6.52E-03	5.02E-07
Te-125m	2.77E-03	8.39E-08	7.60E-03	2.69E-07
I-129	5.74E-01	1.53E-05	6.11E-01	1.61E-05
Cs-134	1.51E-01	3.96E-06	6.37E-01	1.42E-05
Cs-135	1.44E-02	4.58E-07	6.10E-02	1.62E-06
Cs-137+D	1.06E-01	4.36E-06	4.42E-01	1.20E-05
Ba-133	4.62E-03	7.81E-07	7.43E-03	8.61E-07
Pm-147	7.45E-04	4.00E-08	8.49E-04	4.74E-08
Sm-147	1.36E-01	8.92E-07	1.52E-01	1.02E-06
Sm-151	2.80E-04	1.35E-08	3.12E-04	1.56E-08
Eu-150	1.46E-02	4.33E-06	3.41E-02	5.04E-06
Eu-152	1.22E-02	2.77E-06	2.39E-02	3.17E-06
Eu-154	1.51E-02	2.60E-06	2.59E-02	2.95E-06
Eu-155	1.31E-03	7.92E-08	1.73E-03	9.64E-08
Gd-152	1.25E-01	6.90E-07	1.38E-01	7.91E-07
Ho-166m	1.75E-02	6.15E-06	4.40E-02	7.27E-06
Re-187	8.48E-06	9.15E-10	1.22E-05	1.22E-09
Tl-204	4.69E-03	3.11E-07	1.15E-01	8.45E-06
Pb-205	1.09E-03	1.38E-08	2.70E-03	3.83E-08

**Table A-9. Dose and Risk Factors for the All-Pathways Farmer Scencario.
(2 pages)**

Nuclide	Groundwater		Surface Water (Columbia River)	
	mrem per pCi/L	Risk per pCi/L	mrem per pCi/L	Risk per pCi/L
Pb-210+D	3.59E+00	1.94E-05	8.90E+00	5.47E-05
Bi-207	1.41E-02	4.66E-06	3.32E-02	5.38E-06
Po-209	2.01E+00	3.71E-05	2.40E+00	5.11E-05
Po-210	1.53E+00	2.36E-05	1.84E+00	3.47E-05
Ra-226+D	9.81E-01	1.61E-05	1.23E+00	1.99E-05
Ra-228+D	1.05E+00	2.87E-05	1.30E+00	3.62E-05
Ac-227+D	9.46E+00	1.09E-05	1.07E+01	1.27E-05
Th-228+D	5.39E-01	7.28E-06	8.09E-01	1.16E-05
Th-229+D	2.64E+00	1.21E-05	3.98E+00	1.94E-05
Th-230	3.61E-01	1.92E-06	5.42E-01	3.12E-06
Th-232	1.79E+00	7.27E-06	2.71E+00	9.92E-06
Pa-231	6.76E+00	4.00E-06	7.13E+00	4.36E-06
U-232	9.20E-01	1.05E-05	9.76E-01	1.13E-05
U-233	2.03E-01	1.71E-06	2.13E-01	1.81E-06
U-234	1.99E-01	1.68E-06	2.08E-01	1.78E-06
U-235+D	1.89E-01	2.03E-06	1.99E-01	2.16E-06
U-236	1.89E-01	1.59E-06	1.98E-01	1.69E-06
U-238+D	1.88E-01	2.14E-06	1.98E-01	2.27E-06
Np-237+D	2.91E+00	2.04E-06	3.22E+00	2.32E-06
Pu-236	7.45E-01	1.64E-06	8.27E-01	1.86E-06
Pu-238	2.04E+00	2.69E-06	2.27E+00	3.06E-06
Pu-239	2.26E+00	2.77E-06	2.51E+00	3.15E-06
Pu-240	2.26E+00	2.77E-06	2.51E+00	3.15E-06
Pu-241+D	4.37E-02	3.62E-08	4.85E-02	4.11E-08
Pu-242	2.14E+00	2.63E-06	2.38E+00	2.99E-06
Pu-244+D	2.12E+00	4.15E-06	2.36E+00	4.79E-06
Am-241	2.32E+00	2.16E-06	2.58E+00	2.46E-06
Am-242m+D	2.25E+00	1.52E-06	2.50E+00	1.73E-06
Am-243+D	2.32E+00	2.73E-06	2.58E+00	3.14E-06
Cm-242	7.28E-02	7.87E-07	8.08E-02	9.00E-07
Cm-243	1.60E+00	2.21E-06	1.78E+00	2.52E-06
Cm-244	1.29E+00	1.72E-06	1.43E+00	1.95E-06
Cm-245	2.39E+00	2.33E-06	2.66E+00	2.67E-06
Cm-246	2.36E+00	2.10E-06	2.63E+00	2.39E-06
Cm-247+D	2.19E+00	3.14E-06	2.43E+00	3.63E-06
Cm-248	8.69E+00	7.71E-06	9.65E+00	8.76E-06
Cm-250+D	4.97E+01	4.52E-05	5.52E+01	5.15E-05
Bk-247	3.00E+00	2.80E-06	3.40E+00	3.26E-06
Cf-248	2.35E-01	1.04E-06	2.62E-01	1.19E-06
Cf-249	3.42E+00	4.12E-06	3.82E+00	4.73E-06
Cf-250	1.53E+00	2.06E-06	1.71E+00	2.35E-06
Cf-251	3.49E+00	3.48E-06	3.90E+00	3.98E-06
Cf-252	7.71E-01	1.13E-06	8.60E-01	1.29E-06

Table A-10. Dose and Risk Factors for the Native American Scenario.
(2 pages)

Nuclide	Groundwater		Surface Water (Columbia River)	
	mrem per pCi/L	Risk per pCi/L	mrem per pCi/L	Risk per pCi/L
H-3	1.05E-04	1.39E-08	1.19E-04	1.62E-08
Be-10	2.29E-02	1.13E-06	1.15E-01	1.57E-05
C-14	1.15E-02	1.38E-06	2.06E+01	1.38E-03
Na-22	1.04E-01	1.38E-05	1.73E-01	1.83E-05
Si-32+D	6.28E-02	2.82E-06	1.08E-01	8.11E-06
Cl-36	8.11E-02	4.02E-05	1.11E-01	4.33E-05
K-40	7.30E-02	2.21E-05	3.75E+00	4.97E-04
Ti-44+D	1.57E-01	6.65E-05	5.25E+00	6.31E-04
V-49	1.05E-04	1.44E-08	2.53E-03	5.08E-07
Mn-54	1.16E-02	1.24E-06	2.36E-01	1.88E-05
Fe-55	1.20E-03	1.33E-07	2.51E-02	3.34E-06
Co-60	7.73E-02	1.94E-05	1.78E+00	1.19E-04
Ni-59	1.18E-03	1.75E-07	5.34E-03	7.28E-07
Ni-63	3.23E-03	4.16E-07	1.47E-02	1.76E-06
Se-79	2.81E-02	2.12E-06	3.21E-01	2.50E-05
Rb-87	2.43E-02	6.55E-06	1.96E+00	2.02E-04
Sr-90+D	3.84E-01	4.21E-05	2.21E+00	1.23E-04
Zr-93	6.13E-03	1.43E-07	1.04E-01	6.15E-06
Nb-91	9.04E-04	1.36E-07	3.21E-02	5.04E-06
Nb-93m	8.79E-04	9.69E-08	3.18E-02	4.96E-06
Nb-94	3.02E-02	5.20E-05	6.50E-01	1.28E-04
Mo-93	4.00E-03	1.22E-06	6.79E-03	1.83E-06
Tc-99	4.34E-03	4.87E-06	1.02E-02	5.99E-06
Ru-106+D	7.15E-02	9.27E-06	1.28E-01	1.79E-05
Pd-107	1.17E-03	1.26E-07	1.48E-03	1.90E-07
Ag-108m+D	3.19E-02	4.46E-05	2.26E-01	6.97E-05
Cd-109	2.71E-02	7.22E-07	5.44E-01	1.92E-05
Cd-113m	3.45E-01	5.25E-06	6.70E+00	1.06E-04
In-115	4.28E-01	5.77E-06	3.11E+03	5.97E-02
Sn-121m+D	8.29E-03	1.31E-06	1.34E+00	2.13E-04
Sn-126+D	1.00E-01	7.37E-05	1.28E+01	1.74E-03
Sb-125	8.91E-03	1.91E-06	7.45E-02	1.10E-05
Te-125m	6.11E-03	4.50E-07	2.95E-01	2.64E-05
I-129	1.46E+00	1.09E-04	3.67E+00	2.19E-04
Cs-134	3.38E-01	2.01E-05	2.93E+01	1.44E-03
Cs-135	3.27E-02	3.36E-06	2.82E+00	1.66E-04
Cs-137+D	2.37E-01	2.90E-05	2.00E+01	1.07E-03
Ba-133	9.53E-03	4.30E-06	3.53E-02	6.43E-06
Pm-147	3.37E-03	2.54E-07	9.60E-03	1.29E-06
Sm-147	3.69E+00	2.66E-05	4.62E+00	4.47E-05
Sm-151	1.96E-03	8.56E-08	3.92E-03	3.92E-07
Eu-150	3.89E-02	3.19E-05	2.55E-01	5.32E-05
Eu-152	3.28E-02	1.63E-05	1.85E-01	2.99E-05
Eu-154	4.15E-02	1.38E-05	2.13E-01	2.99E-05
Eu-155	4.58E-03	4.31E-07	2.11E-02	2.42E-06
Gd-152	1.13E+01	3.27E-05	1.21E+01	4.74E-05
Ho-166m	6.75E-02	5.56E-05	3.22E-01	9.21E-05
Re-187	2.18E-05	8.61E-09	2.48E-04	5.19E-08
Tl-204	9.32E-03	1.43E-06	6.63E+00	1.14E-03
Pb-205	2.61E-03	7.90E-08	9.92E-02	3.52E-06

**Table A-10. Dose and Risk Factors for the Native American Scenario.
(2 pages)**

Nuclide	Groundwater		Surface Water (Columbia River)	
	mrem per pCi/L	Risk per pCi/L	mrem per pCi/L	Risk per pCi/L
Pb-210+D	8.63E+00	1.15E-04	3.27E+02	5.06E-03
Bi-207	2.70E-02	3.34E-05	1.94E-01	5.24E-05
Po-209	4.63E+00	2.40E-04	2.84E+01	2.20E-03
Po-210	3.54E+00	1.52E-04	2.23E+01	1.71E-03
Ra-226+D	2.73E+00	1.55E-04	1.62E+01	5.63E-04
Ra-228+D	2.73E+00	1.81E-04	1.71E+01	1.18E-03
Ac-227+D	1.00E+02	5.06E-04	1.75E+02	7.47E-04
Th-228+D	1.68E+01	4.93E-04	3.28E+01	1.08E-03
Th-229+D	8.51E+01	7.74E-04	1.65E+02	1.80E-03
Th-230	1.27E+01	1.02E-04	2.36E+01	2.71E-04
Th-232	5.63E+01	2.17E-04	1.11E+02	4.51E-04
Pa-231	7.33E+01	1.56E-04	9.55E+01	2.00E-04
U-232	2.73E+00	1.24E-04	5.51E+00	1.89E-04
U-233	8.16E-01	4.63E-05	1.41E+00	6.08E-05
U-234	8.01E-01	4.55E-05	1.38E+00	5.98E-05
U-235+D	7.51E-01	4.36E-05	1.31E+00	5.89E-05
U-236	7.59E-01	4.21E-05	1.31E+00	5.56E-05
U-238+D	7.41E-01	4.15E-05	1.29E+00	5.98E-05
Np-237+D	3.10E+01	6.92E-05	4.98E+01	1.00E-04
Pu-236	8.25E+00	8.17E-05	1.31E+01	1.11E-04
Pu-238	2.24E+01	1.22E-04	3.60E+01	1.76E-04
Pu-239	2.45E+01	1.21E-04	3.96E+01	1.78E-04
Pu-240	2.45E+01	1.21E-04	3.96E+01	1.78E-04
Pu-241+D	4.72E-01	1.26E-06	7.61E-01	1.95E-06
Pu-242	2.35E+01	1.14E-04	3.78E+01	1.68E-04
Pu-244+D	2.31E+01	1.20E-04	3.72E+01	1.90E-04
Am-241	2.54E+01	1.01E-04	4.09E+01	1.45E-04
Am-242m+D	2.44E+01	5.84E-05	3.94E+01	8.74E-05
Am-243+D	2.52E+01	1.03E-04	4.07E+01	1.52E-04
Cm-242	9.48E-01	5.23E-05	1.42E+00	6.82E-05
Cm-243	1.75E+01	9.80E-05	2.82E+01	1.37E-04
Cm-244	1.42E+01	8.98E-05	2.27E+01	1.23E-04
Cm-245	2.60E+01	1.02E-04	4.20E+01	1.47E-04
Cm-246	2.58E+01	9.97E-05	4.16E+01	1.43E-04
Cm-247+D	2.37E+01	1.01E-04	3.83E+01	1.50E-04
Cm-248	9.44E+01	3.57E-04	1.52E+02	5.14E-04
Cm-250+D	5.38E+02	2.02E-03	8.69E+02	2.92E-03
Bk-247	3.28E+01	1.20E-04	5.65E+01	1.82E-04
Cf-248	2.52E+00	6.29E-05	4.17E+00	8.44E-05
Cf-249	3.35E+01	1.34E-04	5.75E+01	2.01E-04
Cf-250	1.52E+01	9.52E-05	2.58E+01	1.35E-04
Cf-251	3.42E+01	1.28E-04	5.87E+01	1.94E-04
Cf-252	7.87E+00	5.54E-05	1.32E+01	7.73E-05

Table A-11. Risk Factors for the HSRAM Industrial and Residential Scenarios. (2 pages)

Nuclide	HSRAM Industrial	HSRAM Residential	
	Groundwater Risk per pCi/L	Groundwater Risk per pCi/L	Surface Water (Columbia River) Risk per pCi/L
H-3	6.75E-10	2.81E-09	2.85E-09
Be-10	3.54E-08	1.85E-07	5.83E-07
C-14	7.77E-09	5.62E-08	2.98E-05
Na-22	2.96E-07	3.23E-06	3.41E-06
Si-32+D	6.31E-08	3.54E-07	5.77E-07
Cl-36	1.66E-08	1.55E-06	1.62E-06
K-40	1.79E-07	1.76E-06	1.21E-05
Ti-44+D	8.76E-07	1.25E-05	2.53E-05
V-49	6.10E-10	3.14E-09	1.38E-08
Mn-54	4.70E-08	4.66E-07	8.54E-07
Fe-55	4.31E-09	2.20E-08	9.22E-08
Co-60	5.55E-07	6.58E-06	8.92E-06
Ni-59	1.37E-09	7.49E-09	2.26E-08
Ni-63	3.36E-09	1.82E-08	5.42E-08
Se-79	3.65E-08	1.88E-07	6.89E-07
Rb-87	2.62E-08	2.31E-07	4.48E-06
Sr-90+D	3.72E-07	2.62E-06	4.77E-06
Zr-93	5.57E-09	2.85E-08	1.67E-07
Nb-91	4.43E-09	2.79E-08	1.43E-07
Nb-93m	4.03E-09	2.11E-08	1.31E-07
Nb-94	6.16E-07	9.83E-06	1.18E-05
Mo-93	1.68E-08	1.26E-07	1.49E-07
Tc-99	1.38E-08	3.36E-07	3.65E-07
Ru-106+D	2.22E-07	1.21E-06	1.42E-06
Pd-107	1.26E-09	6.78E-09	1.09E-08
Ag-108m+D	5.86E-07	9.11E-06	9.94E-06
Cd-109	2.51E-08	1.31E-07	5.32E-07
Cd-113m	1.44E-07	7.92E-07	3.07E-06
In-115	1.70E-07	8.65E-07	1.29E-03
Sn-121m+D	1.76E-08	9.30E-08	4.69E-06
Sn-126+D	8.41E-07	1.25E-05	4.89E-05
Sb-125	6.73E-08	6.62E-07	8.76E-07
Te-125m	1.67E-08	8.36E-08	6.42E-07
I-129	7.42E-07	3.85E-06	6.97E-06
Cs-134	3.53E-07	2.77E-06	3.34E-05
Cs-135	2.37E-08	1.36E-07	3.66E-06
Cs-137+D	3.27E-07	3.58E-06	2.61E-05
Ba-133	1.10E-07	1.25E-06	1.34E-06
Pm-147	8.47E-09	4.38E-08	6.86E-08
Sm-147	1.92E-07	9.70E-07	1.68E-06
Sm-151	2.79E-09	1.45E-08	2.71E-08
Eu-150	4.78E-07	7.30E-06	8.00E-06
Eu-152	3.37E-07	4.62E-06	5.08E-06
Eu-154	3.41E-07	4.26E-06	4.76E-06
Eu-155	1.40E-08	1.07E-07	1.56E-07
Gd-152	1.55E-07	7.78E-07	1.37E-06
Ho-166m	6.49E-07	1.04E-05	1.14E-05
Re-187	8.98E-11	6.24E-10	1.75E-09
Tl-204	2.94E-08	1.52E-07	2.47E-05

Table A-11. Risk Factors for the HSRAM Industrial and Residential Scenarios. (2 pages)

Nuclide	HSRAM Industrial	HSRAM Residential	
	Groundwater Risk per pCi/L	Groundwater Risk per pCi/L	Surface Water (Columbia River) Risk per pCi/L
Pb-205	3.17E-09	1.63E-08	9.60E-08
Pb-210+D	4.46E-06	2.29E-05	1.35E-04
Bi-207	5.20E-07	7.85E-06	8.52E-06
Po-209	2.37E-06	1.83E-05	6.43E-05
Po-210	1.89E-06	1.38E-05	4.73E-05
Ra-226+D	2.62E-06	2.13E-05	3.34E-05
Ra-228+D	5.67E-06	3.29E-05	5.72E-05
Ac-227+D	2.63E-06	1.42E-05	2.26E-05
Th-228+D	1.73E-06	9.63E-06	2.26E-05
Th-229+D	2.90E-06	1.55E-05	4.32E-05
Th-230	4.78E-07	2.43E-06	6.96E-06
Th-232	9.40E-07	1.13E-05	1.75E-05
Pa-231	9.33E-07	5.22E-06	7.80E-06
U-232	1.87E-06	1.38E-05	1.63E-05
U-233	3.68E-07	1.88E-06	2.49E-06
U-234	3.62E-07	1.85E-06	2.45E-06
U-235+D	4.02E-07	2.42E-06	3.06E-06
U-236	3.43E-07	1.75E-06	2.32E-06
U-238+D	4.49E-07	2.37E-06	3.16E-06
Np-237+D	4.10E-07	2.76E-06	3.99E-06
Pu-236	3.98E-07	2.13E-06	2.87E-06
Pu-238	6.80E-07	3.41E-06	5.62E-06
Pu-239	7.00E-07	3.51E-06	5.94E-06
Pu-240	7.00E-07	3.51E-06	5.94E-06
Pu-241+D	9.10E-09	4.60E-08	6.81E-08
Pu-242	6.64E-07	3.33E-06	5.64E-06
Pu-244+D	8.64E-07	5.78E-06	8.68E-06
Am-241	5.43E-07	2.74E-06	4.61E-06
Am-242m+D	3.80E-07	1.94E-06	3.10E-06
Am-243+D	6.11E-07	3.67E-06	5.75E-06
Cm-242	2.01E-07	9.97E-07	1.35E-06
Cm-243	5.21E-07	2.91E-06	4.38E-06
Cm-244	4.36E-07	2.17E-06	3.33E-06
Cm-245	5.60E-07	3.03E-06	4.96E-06
Cm-246	5.31E-07	2.66E-06	4.50E-06
Cm-247+D	6.28E-07	4.44E-06	6.45E-06
Cm-248	1.94E-06	9.73E-06	1.65E-05
Cm-250+D	1.12E-05	5.76E-05	9.65E-05
Bk-247	6.69E-07	3.64E-06	6.06E-06
Cf-248	2.32E-07	1.16E-06	1.64E-06
Cf-249	7.68E-07	5.12E-06	7.67E-06
Cf-250	4.49E-07	2.25E-06	3.49E-06
Cf-251	7.15E-07	3.96E-06	6.53E-06
Cf-252	2.52E-07	1.25E-06	1.78E-06

Table A-12. Risk Factors for the HSRAM Agricultural and Recreational Scenarios. (2 pages)

Nuclide	HSRAM Agricultural		HSRAM Recreational	
	Groundwater Risk per pCi/L	Surface Water (Columbia River) Risk per pCi/L	Groundwater Risk per pCi/L	Surface Water (Columbia River) Risk per pCi/L
H-3	3.31E-09	3.35E-09	4.73E-11	9.22E-11
Be-10	1.91E-07	5.89E-07	2.99E-09	3.08E-07
C-14	2.40E-07	2.99E-05	6.54E-10	2.97E-05
Na-22	4.50E-06	4.67E-06	2.32E-08	1.87E-07
Si-32+D	3.56E-07	5.79E-07	5.33E-09	1.11E-07
Cl-36	6.72E-06	6.79E-06	1.39E-09	6.74E-08
K-40	3.83E-06	1.42E-05	1.60E-08	1.03E-05
Ti-44+D	1.46E-05	2.74E-05	8.74E-08	1.25E-05
V-49	3.35E-09	1.41E-08	5.13E-11	1.07E-08
Mn-54	4.67E-07	8.55E-07	3.57E-09	3.90E-07
Fe-55	3.40E-08	1.04E-07	3.63E-10	6.93E-08
Co-60	6.73E-06	9.07E-06	4.62E-08	2.34E-06
Ni-59	3.31E-08	4.82E-08	1.16E-10	1.17E-08
Ni-63	8.02E-08	1.16E-07	2.83E-10	2.87E-08
Se-79	4.12E-07	9.12E-07	3.07E-09	4.93E-07
Rb-87	8.10E-07	5.06E-06	2.21E-09	4.20E-06
Sr-90+D	6.45E-06	8.61E-06	3.14E-08	1.74E-06
Zr-93	2.85E-08	1.67E-07	4.69E-10	1.29E-07
Nb-91	2.79E-08	1.43E-07	3.83E-10	1.05E-07
Nb-93m	2.11E-08	1.31E-07	3.39E-10	1.05E-07
Nb-94	9.83E-06	1.18E-05	6.51E-08	1.91E-06
Mo-93	1.67E-07	1.90E-07	1.41E-09	1.41E-08
Tc-99	4.72E-07	5.01E-07	1.16E-09	2.50E-08
Ru-106+D	2.61E-06	2.83E-06	1.85E-08	2.07E-07
Pd-107	2.29E-08	2.71E-08	1.06E-10	1.26E-09
Ag-108m+D	9.13E-06	9.96E-06	6.06E-08	8.11E-07
Cd-109	1.55E-07	5.56E-07	2.11E-09	4.00E-07
Cd-113m	9.68E-07	3.24E-06	1.21E-08	2.18E-06
In-115	1.08E-06	1.29E-03	1.43E-08	1.29E-03
Sn-121m+D	3.50E-07	4.95E-06	1.49E-09	4.56E-06
Sn-126+D	1.45E-05	5.09E-05	8.72E-08	3.61E-05
Sb-125	6.63E-07	8.76E-07	5.37E-09	2.13E-07
Te-125m	9.45E-08	6.53E-07	1.40E-09	5.60E-07
I-129	2.33E-05	2.64E-05	6.25E-08	2.38E-06
Cs-134	5.59E-06	3.62E-05	2.86E-08	3.06E-05
Cs-135	5.94E-07	4.12E-06	2.00E-09	3.50E-06
Cs-137+D	6.31E-06	2.89E-05	3.03E-08	2.25E-05
Ba-133	1.26E-06	1.36E-06	9.72E-09	8.38E-08
Pm-147	5.02E-08	7.51E-08	7.12E-10	2.29E-08
Sm-147	1.11E-06	1.82E-06	1.60E-08	3.77E-07
Sm-151	1.69E-08	2.95E-08	2.35E-10	6.36E-09
Eu-150	7.32E-06	8.01E-06	4.80E-08	7.02E-07
Eu-152	4.65E-06	5.10E-06	3.12E-08	4.52E-07
Eu-154	4.30E-06	4.81E-06	3.00E-08	4.85E-07
Eu-155	1.14E-07	1.64E-07	1.17E-09	4.53E-08
Gd-152	8.59E-07	1.45E-06	1.28E-08	3.05E-07
Ho-166m	1.04E-05	1.15E-05	6.85E-08	1.06E-06
Re-187	1.16E-09	2.29E-09	7.58E-12	9.24E-10

Table A-12. Risk Factors for the HSRAM Agricultural and Recreational Scenarios. (2 pages)

Nuclide	HSRAM Agricultural		HSRAM Recreational	
	Groundwater Risk per pCi/L	Surface Water (Columbia River) Risk per pCi/L	Groundwater Risk per pCi/L	Surface Water (Columbia River) Risk per pCi/L
Tl-204	3.81E-07	2.49E-05	2.47E-09	2.45E-05
Pb-205	1.73E-08	9.69E-08	2.67E-10	7.39E-08
Pb-210+D	2.43E-05	1.36E-04	3.76E-07	1.07E-04
Bi-207	7.86E-06	8.53E-06	5.18E-08	6.73E-07
Po-209	2.99E-05	7.59E-05	1.99E-07	4.20E-05
Po-210	1.96E-05	5.31E-05	1.59E-07	3.36E-05
Ra-226+D	2.41E-05	3.63E-05	2.36E-07	8.97E-06
Ra-228+D	4.03E-05	6.46E-05	4.78E-07	2.21E-05
Ac-227+D	1.42E-05	2.26E-05	2.18E-07	5.25E-06
Th-228+D	9.63E-06	2.26E-05	1.40E-07	1.28E-05
Th-229+D	1.56E-05	4.32E-05	2.39E-07	2.18E-05
Th-230	2.44E-06	6.96E-06	3.96E-08	3.60E-06
Th-232	1.13E-05	1.75E-05	1.00E-07	5.16E-06
Pa-231	5.22E-06	7.80E-06	7.91E-08	8.75E-07
U-232	1.44E-05	1.69E-05	1.64E-07	1.66E-06
U-233	2.04E-06	2.65E-06	3.06E-08	3.25E-07
U-234	2.00E-06	2.61E-06	3.01E-08	3.20E-07
U-235+D	2.58E-06	3.23E-06	3.40E-08	3.57E-07
U-236	1.90E-06	2.47E-06	2.85E-08	3.03E-07
U-238+D	2.57E-06	3.36E-06	3.76E-08	4.10E-07
Np-237+D	2.82E-06	4.04E-06	3.52E-08	6.86E-07
Pu-236	2.13E-06	2.87E-06	3.32E-08	6.67E-07
Pu-238	3.41E-06	5.62E-06	5.62E-08	1.13E-06
Pu-239	3.51E-06	5.94E-06	5.79E-08	1.17E-06
Pu-240	3.51E-06	5.94E-06	5.79E-08	1.17E-06
Pu-241+D	4.60E-08	6.81E-08	7.56E-10	1.52E-08
Pu-242	3.33E-06	5.64E-06	5.49E-08	1.11E-06
Pu-244+D	5.78E-06	8.68E-06	7.47E-08	1.48E-06
Am-241	2.75E-06	4.61E-06	4.49E-08	9.04E-07
Am-242m+D	1.94E-06	3.11E-06	3.16E-08	6.12E-07
Am-243+D	3.67E-06	5.76E-06	5.18E-08	1.04E-06
Cm-242	1.00E-06	1.35E-06	1.64E-08	3.58E-07
Cm-243	2.92E-06	4.39E-06	4.35E-08	8.57E-07
Cm-244	2.18E-06	3.34E-06	3.59E-08	7.19E-07
Cm-245	3.04E-06	4.97E-06	4.67E-08	9.38E-07
Cm-246	2.67E-06	4.51E-06	4.39E-08	8.81E-07
Cm-247+D	4.45E-06	6.46E-06	5.47E-08	1.06E-06
Cm-248	9.77E-06	1.65E-05	1.61E-07	3.23E-06
Cm-250+D	5.78E-05	9.67E-05	9.32E-07	1.87E-05
Bk-247	3.64E-06	6.07E-06	5.59E-08	1.30E-06
Cf-248	1.29E-06	1.78E-06	1.90E-08	4.81E-07
Cf-249	5.59E-06	8.14E-06	6.61E-08	1.46E-06
Cf-250	2.56E-06	3.80E-06	3.70E-08	8.77E-07
Cf-251	4.45E-06	7.02E-06	5.99E-08	1.39E-06
Cf-252	1.41E-06	1.94E-06	2.07E-08	4.90E-07

Table A-13. Dose and Risk Factors for the Columbia River Population. (2 pages)

Nuclide	Dose	Risk
	mrem per pCi/L	Risk per pCi/L
H-3	2.36E-01	3.08E-02
Be-10	1.49E+01	1.77E+00
C-14	2.19E+01	2.30E+00
Na-22	2.09E+02	2.95E+01
Si-32+D	3.49E+01	3.56E+00
Cl-36	9.82E+01	4.69E+01
K-40	1.28E+02	3.58E+01
Ti-44+D	3.13E+02	1.57E+02
V-49	1.99E-01	2.99E-02
Mn-54	2.80E+01	2.97E+00
Fe-55	2.69E+00	3.07E-01
Co-60	2.05E+02	4.79E+01
Ni-59	1.54E+00	2.15E-01
Ni-63	4.22E+00	5.12E-01
Se-79	5.63E+01	4.19E+00
Rb-87	3.60E+01	8.27E+00
Sr-90+D	6.90E+02	6.12E+01
Zr-93	5.11E+00	2.54E-01
Nb-91	1.73E+00	2.83E-01
Nb-93m	1.60E+00	1.87E-01
Nb-94	1.21E+02	1.33E+02
Mo-93	5.17E+00	1.75E+00
Tc-99	7.68E+00	7.76E+00
Ru-106+D	1.65E+02	2.22E+01
Pd-107	8.65E-01	1.58E-01
Ag-108m+D	1.23E+02	1.14E+02
Cd-109	4.48E+01	1.30E+00
Cd-113m	5.56E+02	8.61E+00
In-115	8.19E+02	1.45E+01
Sn-121m+D	1.94E+01	3.14E+00
Sn-126+D	3.06E+02	1.89E+02
Sb-125	2.20E+01	4.49E+00
Te-125m	1.31E+01	9.10E-01
I-129	2.42E+03	1.56E+02
Cs-134	6.49E+02	3.97E+01
Cs-135	6.12E+01	5.84E+00
Cs-137+D	4.63E+02	6.02E+01
Ba-133	2.68E+01	1.03E+01
Pm-147	3.54E+00	4.35E-01
Sm-147	6.43E+02	1.00E+01
Sm-151	1.33E+00	1.51E-01
Eu-150	1.05E+02	8.07E+01
Eu-152	7.73E+01	4.05E+01
Eu-154	8.72E+01	3.37E+01
Eu-155	6.46E+00	8.86E-01
Gd-152	5.79E+02	7.80E+00
Ho-166m	1.34E+02	1.40E+02
Re-187	3.89E-02	1.33E-02
Tl-204	2.09E+01	3.19E+00
Pb-205	5.25E+00	1.59E-01
Pb-210+D	1.73E+04	2.18E+02

Table A-13. Dose and Risk Factors for the Columbia River Population. (2 pages)

Nuclide	Dose	Risk
	mrem per pCi/L	Risk per pCi/L
Bi-207	1.03E+02	8.49E+01
Po-209	9.31E+03	4.03E+02
Po-210	7.12E+03	2.33E+02
Ra-226+D	4.69E+03	2.61E+02
Ra-228+D	5.00E+03	3.18E+02
Ac-227+D	4.58E+04	1.28E+02
Th-228+D	2.59E+03	8.02E+01
Th-229+D	1.27E+04	1.49E+02
Th-230	1.73E+03	2.32E+01
Th-232	8.65E+03	1.99E+02
Pa-231	3.27E+04	5.69E+01
U-232	4.41E+03	1.39E+02
U-233	9.67E+02	1.90E+01
U-234	9.47E+02	1.87E+01
U-235+D	9.00E+02	2.43E+01
U-236	9.00E+02	1.77E+01
U-238+D	8.97E+02	2.41E+01
Np-237+D	1.40E+04	2.86E+01
Pu-236	3.60E+03	1.93E+01
Pu-238	9.88E+03	3.05E+01
Pu-239	1.09E+04	3.16E+01
Pu-240	1.09E+04	3.16E+01
Pu-241+D	2.11E+02	4.17E-01
Pu-242	1.04E+04	3.00E+01
Pu-244+D	1.03E+04	6.20E+01
Am-241	1.12E+04	2.49E+01
Am-242m+D	1.09E+04	1.78E+01
Am-243+D	1.12E+04	3.72E+01
Cm-242	3.52E+02	8.75E+00
Cm-243	7.76E+03	2.67E+01
Cm-244	6.24E+03	1.93E+01
Cm-245	1.16E+04	2.89E+01
Cm-246	1.14E+04	2.40E+01
Cm-247+D	1.06E+04	4.90E+01
Cm-248	4.21E+04	8.80E+01
Cm-250+D	2.40E+05	5.30E+02
Bk-247	1.45E+04	3.48E+01
Cf-248	1.11E+03	1.13E+01
Cf-249	1.62E+04	5.87E+01
Cf-250	7.25E+03	2.26E+01
Cf-251	1.66E+04	4.28E+01
Cf-252	3.65E+03	1.23E+01